

CLAIMS

What is claimed is:

- 1 1. In the operation of a fuel cell system comprising
2 (A) a fuel cell and (B) a source of organic fuel,
3 (C) a source of air, and (D) a fuel processing
4 system for converting an organic fuel into hydrogen,
5 the fuel processing system comprising multiple
6 catalytic fuel processing components, including a
7 fuel reformer in series flow relationship with a
8 catalytic shift converter, wherein, during fuel cell
9 operation, a load is connected across the cell and
10 organic fuel from the source is directed, in series,
11 through the fuel reformer, the shift converter, and
12 fuel cell anode flow field, a procedure for shutting
13 down the fuel cell and fuel processing system
14 comprising the steps of:
 - 15 a. disconnecting the load from the cell and
16 halting the flow of organic fuel from the
17 source to the fuel processing system; and, then
18 b. purging the reformer of residual hydrogen by
19 flowing air through the reformer.
- 1 2. The shut-down procedure according to claim 1,
2 wherein, after step (a), the additional step (c) of
3 purging the shift converter of residual hydrogen by
4 flowing air through the shift converter.
- 1 3. The shut-down procedure according to claim 1,
2 wherein the reformer and fuel cell are purged of
3 residual hydrogen by passing air, in series, through
4 the reformer and thereafter through the fuel cell
5 anode flow field.
- 1 4. The shut-down procedure according to claim 1,
2 wherein the air purge of the reformer in step (b) is
3 continued at least until the concentration of
4 hydrogen in the gas stream leaving the reformer is
5 below 4%, by volume.

- 1 5. The shut-down procedure according to claim 1,
2 wherein the shift converter and reformer are purged
3 of residual hydrogen by passing air through the
4 reformer and shift converter.
- 1 6. The shut-down procedure according to claim 5,
2 wherein purging step (b) also includes passing a
3 flow of steam through the reformer and then the
4 shift converter.
- 1 7. The shut-down procedure according to claim 6,
2 wherein in purging step (b) the steam and purge air
3 are introduced into the reformer substantially
4 simultaneously.
- 1 8. The shut-down procedure according to claim 6
2 wherein, in purging step (b), the steam flow through
3 the reformer is done immediately prior to purging
4 the reformer with air.
- 1 9. The shut-down procedure according to claim 1,
2 wherein a selective oxidizer is disposed downstream
3 of the shift converter, and step (b) also includes
4 purging the shift converter and selective oxidizer
5 of residual hydrogen by passing air, in series,
6 through the reformer, shift converter, and selective
7 oxidizer.
- 1 10. The shut-down procedure according to claim 1,
2 wherein a desulfurizer is disposed upstream of the
3 reformer, and step (b) also includes purging the
4 desulfurizer of residual hydrogen by passing air, in
5 series, through the desulfurizer, reformer, shift
6 converter, and selective oxidizer.
- 1 11. The shut-down procedure according to claim 1,
2 wherein the reformer and at least one other
3 catalytic component of the fuel processing system is
4 purged of residual hydrogen by flowing air through
5 the reformer and such at least one other component,
6 in series, wherein the volume of air used for such

7 purging step is at least three times the volume of
8 the largest purged component.

1 12. The shut-down procedure according to claim 1,
2 wherein the volume of air used to purge the reformer
3 is at least three times the volume of the reformer.

1 13. The shut-down procedure according to claim 1,
2 wherein in step (b) of purging the reformer using
3 air, the purge air is introduced into the reformer
4 through an inlet that is located at a low point of
5 the reformer volume and passes through the reformer
6 by natural circulation, exiting the reformer through
7 an outlet that is located at a high point of the
8 reformer volume.

1 14. The shut-down procedure according to claim 1,
2 wherein the fuel processing system includes a
3 reformer and at least one other catalytic fuel
4 processing component arranged vertically in a stack,
5 one above the other, and in series flow
6 relationship, wherein, in step (b), the reformer and
7 such at least one other components are purged of
8 residual hydrogen by flowing air therethrough, in
9 series, wherein the purge air is allowed into the
10 stack through an inlet that is located at a low
11 point of the vertically lowest of such catalytic
12 component to be purged with air, and such air passes
13 in series, by natural circulation, through each such
14 fuel processing system component to be purged,
15 exiting the highest of such catalytic components to
16 be purged through an outlet that is located at a
17 high point of such highest component.

1 15. The shut-down procedure according to claim 14,
2 wherein the purge air flows through the stack in a
3 direction opposite to the direction of flow that
4 occurs during the processing of organic fuel to
5 produce hydrogen.

- 1 16. The shut-down procedure according to claim 14,
2 wherein the purging by natural circulation of air is
3 allowed to continue until the hydrogen concentration
4 in the purge gases exiting the stack of fuel
5 processing components comprises less than 4%
6 hydrogen.
- 1 17. The shut-down procedure according to claim 14,
2 wherein, in step (b), the purge air is allowed into
3 and out of the stack of fuel processing components
4 through valves which are kept closed by energy
5 produced by the fuel cell during normal fuel cell
6 operation, and which are de-energized and
7 automatically open when the load is disconnected
8 from the cell stack in step (a).
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